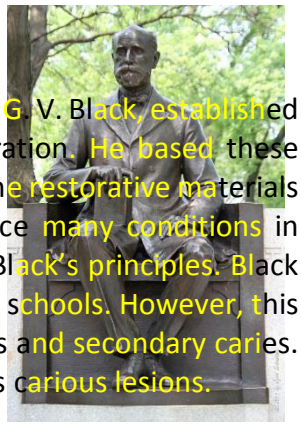
Operative dentistry is the art and science of the diagnosis, treatment, and prognosis of defects of teeth that do not require full coverage restorations for correction. Such treatment should result in the restoration of proper tooth form, function, and esthetics while maintaining the physiologic integrity of the teeth in harmonious relationship with the adjacent hard and soft tissues, all of which should enhance the general health and welfare of the patient **(The art and science of operative dentistry / senior editor, Clifford M. Sturdevant; co-editors, Theodore M. Roberson, Harald O. Heymann, John R. Sturdevant. 3rd ed. c1995).**



G. V. Black: (Chicago, Illinois 1836-1915)

In the first decade of the twentieth century an American dentist and teacher, G. V. Black, established principles governing the design of cavities and suggested steps in their preparation. He based these principles on what was known at the time about the natural history of caries and the restorative materials available. Since his principles have now been so extensively modified, and since many conditions in addition to caries are treated operatively, no further reference will be made to Black's principles. Black also described a classification of carious lesions which is still widely used in dental schools. However, this classification is now regarded as incomplete in that it does not include root caries and secondary caries. Also, it does not include non-carious lesions, which are treated in the same way as carious lesions.

Cavity preparation: The mechanical alteration of a defective, injured, or diseased tooth in order to best receive a restorative material which will re-establish a healthy state for the tooth including esthetic corrections where indicated, along with normal form and function. Axial wall an axial wall is an internal wall parallel with the long axis of the tooth. Pulpal wall a pulpal wall is an internal wall that is perpendicular to the long axis tooth and occlusal of pulp.

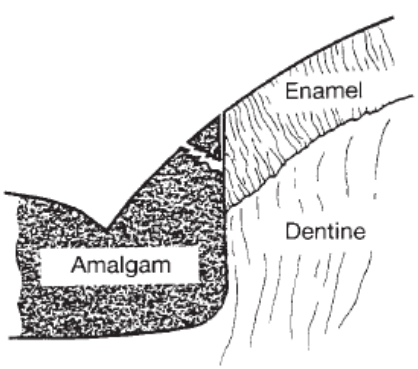
When is a restoration needed?

One of the most important reasons for placing a restoration is to aid plaque control. Other reasons where a restoration may be needed include:

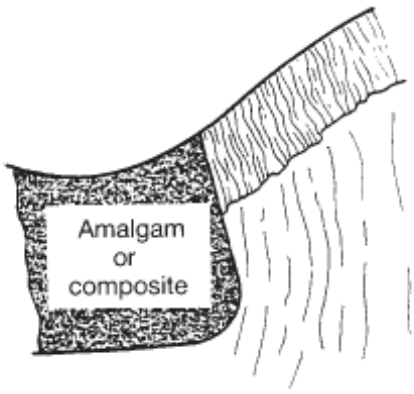
- the tooth is sensitive to hot, cold, and sweet.
- the pulp is endangered.
- previous attempts to arrest the lesion have failed and there is evidence that the lesion is progressing.
- function is impaired.
- drifting is likely through loss of contact point.
- the carious lesion is unsightly.

Dental amalgam:

Amalgam is an alloy of mercury with silver and other metals such as tin and copper to give a set material which does not adhere to tooth structure and therefore needs to be retained within the cavity by mechanical means. Although amalgam does not adhere to the tooth surface, it has been shown that there is a reduction in micro-leakage around amalgam restorations over a period of time, and this is attributed to corrosion products forming at the tooth– amalgam interface. Amalgam is condensed into a cavity with more force than other materials and this must be resisted by the design of the cavity preparation. Until now the concept has been to remove diseased hard tissue and replace it with little more than a plug in a hole. Plastic restorations are used intracoronally. Materials include amalgam, resin composite, glass ionomer less commonly resin modified glass ionomers and cermets, although their frequency of use is increasing. **Placement of a satisfactory restoration requires sound cavity preparation. These materials require considerably less amount of tooth preparation. But their success is limited due to their poor strength.**



A



B

An amalgam restoration prepared and carved so that the amalgam margin angle is too acute. This increases the likelihood of fracture of the amalgam margin. Modification to the angles shown in Fig. B, is required for sufficient strength of the amalgam.

The type of material used for the restoration can be determined based on the following factors:

1. Viscosity of saliva.

2. Age (younger patients need stronger materials like metal crowns).

3. Amount of occlusal load (Full veneer crowns are preferred for areas under high stress).

4. Type of opposing teeth (Stronger materials are needed for restorations opposing natural teeth).

5. Existing state of oral hygiene (Fluoride releasing materials can be used for patients with high caries index).

6. Amount of remaining tooth structure (Partial veneer crowns are preferred for teeth with minimal destruction).

Types of replacement:

1-**Intracoronal Replacements** Gold is the metal most commonly used for intracoronal restorations. It gives an excellent fit and finish. The major disadvantage is that they require extensive tooth preparation even for small lesions.

2-Extracoronal Replacements They are used for teeth with extensive carious lesions. The material requires extensive tooth preparation. Since the margins are placed near the gingival margin, periodontal health may be affected.

Principles of Cavity Preparation:

1- Objective of Cavity Preparation:

A-Removal of carious or fractured tooth tissue.

B- Prevention of secondary caries.

C- Minimize pulpal or periodontal damage.

D- Cavity should be prepared such that the filling material to be used can restore function and appearance of the tooth and is retained in the tooth.

2-Basic Principles of Cavity Preparation:

Although cavities vary widely, the following basic steps are common to the preparation of most cavities:

A. Outline form.

B. Resistance form.

C. Retention form.

D. Management of remaining caries.

E. Enamel margin finishing.

F. Cavity toilet.

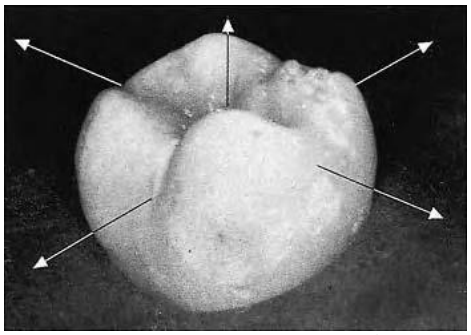
A-Outline Form:

This is the cavity outline. Generally outline form encompasses the carious lesion, grossly unsupported enamel, and is made up of smooth angles rather than sharp edges. In the past outline form included adjacent areas which may become carious (i.e. '*extension for prevention*'); thus the complete fissure system was included in a cavity outline. Whilst the outline form of some types of cavity may well require some extension to satisfy resistance and retention form, it is hard to justify 'extension for prevention' in modern cavity design. Ideally cavity outline should be self-cleansing, supragingival and not exposed to occlusal trauma. This ideal is frequently compromised by the extent of the caries and pre-existing restorations. an initial depth of 0.2~0.8 mm pulpally of the dentinoenamel junction.

B&C- Resistance and Retention Forms:

These are considered together as they are achieved together (**Resistance form** refers to the features of the cavity design which resist occlusal forces. **Retention form** refers to the features of the cavity design which resist displacement of the final restoration). Retention form may vary depending on the material that will fill the cavity, e.g. a cavity to be filled by resin composite gains additional retention via micromechanical retention from acid etching of enamel. Therefore such a cavity requires less retention than a cavity that will be restored by a material such as amalgam.

An occlusal–palatal cavity, both parts of which are independently retentive.



Cavities should be designed with retentive features which prevent the restoration being lost in all five directions and at any angle between them.

General requirements of cavities:

-Undercut: If the internal cavity diameter is greater than the marginal diameter the cavity is undercut. Additional undercut can be achieved by preparation of grooves or notches in dentinal walls. Main walls should be near parallel If there is near-parallelism then, due to the close contact of restorative material to the walls, the material will be difficult to displace.

-Dovetail lock: Mesial or distal displacement can be resisted by preparation of such a lock in the occlusal surface of a tooth. Lock diameter should not weaken cusps, and form is dependent on tooth anatomy.

-Flat floors: Resist occlusal forces favorably.

E. Managements of Remaining Caries

Caries will be removed by preparation of outline, resistance and retention form. Usually there will be some caries left after this has been performed. Removal of existing caries should be undertaken with the following principles in mind:

1.The cavity margin must be caries free.

2.Great care should be taken to remove all caries and stained dentine from the amelodentinal junction.

3. Stained but hard dentine may be left in the deepest parts of the cavity.

4. Soft dentine should be removed.

F. Enamel Margin Finishing

In most cavities the cavosurface angle (solid-line angle between cavity wall and tooth surface) should be 90º. Cavity margins should be closely inspected and gross unsupported enamel removed. However, the marginal strength of the restorative material for a particular cavity is a factor in determining the best cavosurface angle and the amount of unsupported enamel to be removed.

G. Cavity Toilet

After mechanical cavity preparation is complete, residual debris should be dislodged with a hand instrument, the cavity cleaned with water spray, isolated and dried.

Classification of Cavities

Black's cavity classification is a simple way of classifying cavities based on tooth surface affected:
Class I- Cavity originating in anatomical pit or fissure.
Class II Cavity originating on mesial or distal aspect of molar/ premolar teeth.
Class III Cavity originating on mesial or distal aspect of incisors/canines not involving incisal edge.
Class IV Cavity originating on mesial or distal aspect of incisors/canines involving incisal edge.
Class V Cavity originating in cervical third of buccal/lingual/palatal aspects of teeth (excluding anatomical pits).

Cavity Preparation for Class I and V Cavities:

Classical cavity preparations for Class I cavities are usually described when the restorative material will be amalgam.

Cavity Preparation for Class III and IV Cavities:

Classical Class III and IV cavities are described for resin composite restorations.

CLASS I

- Initial preparation with air turbine.
- Do *not* overextend outline form.
- Small burs preferable.
- Caries removal with rose head bur (large or small depending on extent of caries).
- Floor usually as flat as possible.
- Cavosurface angle usually 110º.
- Cavity margins in non-stagnation areas to minimise risk of recurrent caries.

Principles :

1.All friable and weakened enamel should be removed.
2.All fault should be included 3.All margin should be placed in a position to afford good finishing of margins of restoration.

Features:

1.Preserving cuspal strength(Preserving cuspal strength -avoiding termination of the margin on extreme eminence, such as cusp height -if extension of primary groove includes half / > of cusp incline, then CUSP CAPPING consider)

2.Preserving marginal ridge (Preserving marginal ridge strength, Remaining Marginal ridge should be greater than 1.6 mm for premolar & 2mm for molar, If Remaining Marginal ridge will be less than 1.6 mm there there may be the chances of fracture due to undermining the ridge. Direction of mesial & distal walls, When >1.6 mm thickness width is remained at mesial /distal marginal ridge , then mesial / distal

wall should be parallel. When less than/= 1.6 mm thickness width is remained at mesial /distal marginal ridge , then mesial / distal wall should be divergent.).

3.Minimizing facio-lingual extension (Minimizing facio –lingual Extension - Minimizing facio – lingual Extension ,which prevents the weakening of cusp. - For conservative class I Cavity facio-lingual width should be 1 to 1.5 mm. Depth of preparation Restricting depth of penetration into dentin for pits and fissure-0.2 for smooth surface-0.2 to 0.8 Because:

a.To avoid the seating of the restoration on the very sensitive DEJ.

b.To give the bulk of restoration.

c.To take advantages of dentin elasticity during insertion and function.

Facio-lingual width should be not more than ¼ th the intercuspal distance . As minimum tooth structure is removed, it increases the resistance of tooth. ¼ th intercuspal distance).

4.Using enameloplasty (This is the procedure of reshaping the enamel surface by making it rounded / Saucered ,the area becomes cleansable and finishable. It is indicated when remaining fissure is not greater than 1/3 rd of enamel thickness).

5.Connectiong two close faults of the tooth which are < 0.5 mm apart.

6.Restricting depth of penetration into dentin for pits and fissure-0.2 for smooth surface-0.2 to 0.8.

6.In upper molars if cavity involves all the occlusal surfaces ,the preparation elongated mesio-distally . If the oblique ridge is not involved the mesial preparation will assume kidney shape & distal will appear as heart shape . In class II the shape of proximal box is Inverted Truncated Cone.

CLASS V

• Gingival margin of outline form often *subgingival* due to caries.
• May need retraction cord to arrest gingival haemorrhage.
• Floor parallel to crown/root surface.
• If amalgam to be used, may need undercuts in occlusal and gingival walls (use inverted cone or small rose head bur).

Cavity Preparation for Class II Cavities:

Classical Class II cavity is described for amalgam restoration.

• Access via occlusal surface with air turbine to define outline. Use small burs to prevent overextension.
• Cavity through enamel to dentine.
• Proceed axially removing caries; do not open cavity too much laterally.
• Remove marginal ridge to 0.5 mm thickness, then use low-speed handpiece to complete marginal ridge removal –decreases risk of damage to adjacent tooth.
• Hand instruments useful in defining enamel margins.
• Cavity should be extended so that box margins are self-cleansing.
• Where possible, the box margins should be supragingival (often compromised due to caries).
• Retention achieved by parallel walls and dovetail lock.
• If additional retention is required, grooves/notches may be cut in axial walls of box.
• Floor of occlusal part and box as flat as possible. Diagrammatic representations of the classical Class II cavity preparation for amalgam are shown in Figures 1 and 2.

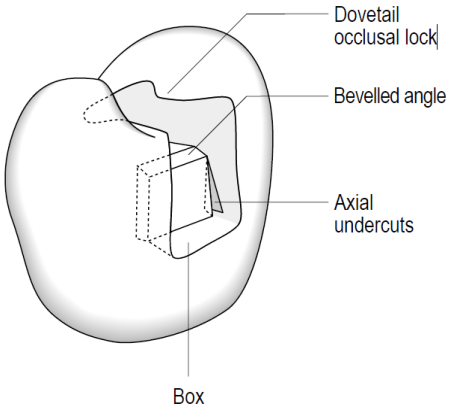


Figure 1. Class II cavity

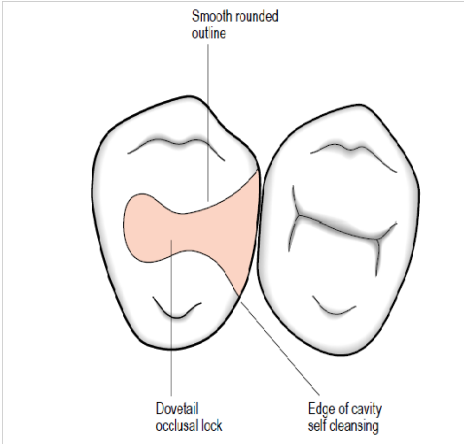
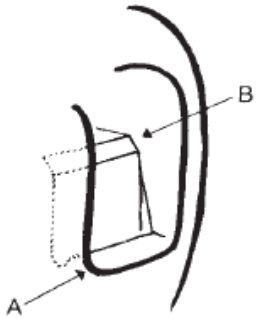
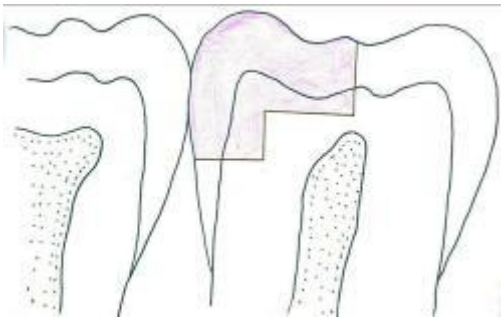
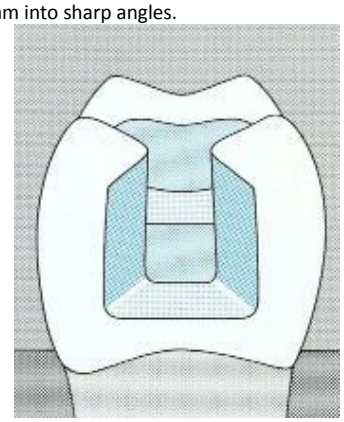


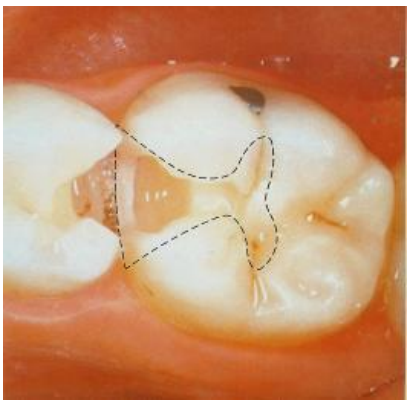
Figure 2. Class II restoration.

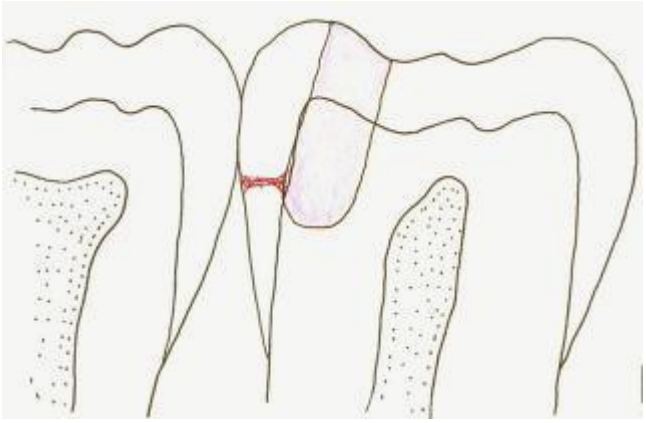
The proximal box of an occlusal–proximal amalgam cavity. The angle between the occlusal floor and axial wall of the box has been beveled (B). Note also that the corners of the box are also rounded (A) to reduce the risk of voids in the amalgam here, resulting from the difficulty in packing amalgam into sharp angles.

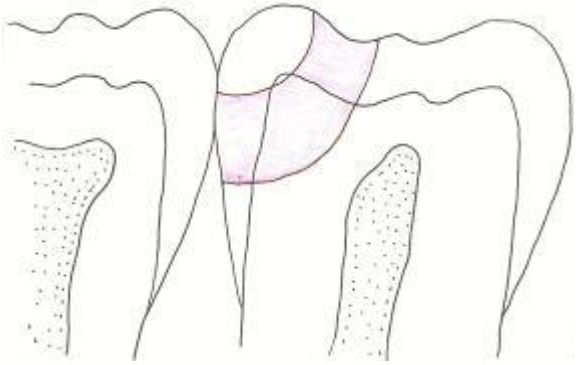












Tunnel preparations

Useful for early carious cavities on mesial and distal surfaces which just penetrate to dentine. Penetrate occlusally and 'tunnel' under marginal ridge to contact area *preserving* marginal ridge. Remove caries from occlusal surface through tunnel. Restore by packing into cavity from occlusal surface using matrix band. If extent of caries is misjudged, residual caries may be left around margins.

The shape and position of the cavity margin

The shape of the cavity margin will largely be determined by the choice of material. Amalgam and porcelain cavity margins should be finished at approximately 90 degrees. Cast metal restorations can be finished to acute angles, and so the cavity margin can be a very oblique bevel. The shape of the margin for composite restorations may be bevelled in some cases to improve retention and appearance. The position of the cavity margin is largely determined by the caries but cavity margins should be supragingival wherever possible to improve access for cleaning. In posterior restorations involving the approximal surface, a decision must be made as to whether or not the margin of the preparations should be extended beyond the contact area to improve access for cleaning. Traditionally, it has always been cut clear of the contact area, but this should no longer be an automatic decision. Cutting the cavity free of the contact area may well be more destructive than is necessary in a number of cases. The important consideration is how the patient can clean the margin so that further caries may be prevented. With anterior approximal restorations the cavity margin is commonly left in contact with the adjacent teeth for aesthetic reasons and because access for cleaning is good anteriorly.

The classification of instruments:

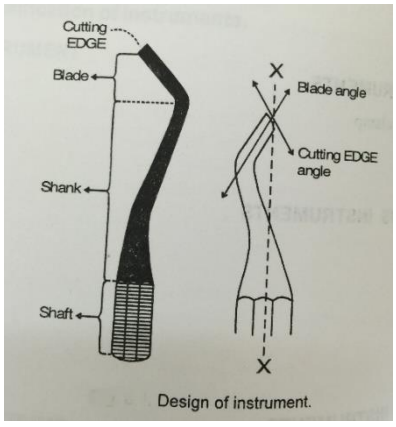
a- Catting instruments:

1-Hand:

-Hatchets.

-Chisels.

-Excavators.



Design of instrument.

2-Rotary:

-Burs.

-Stones.

-Discs.

b-Condensing instruments:

1-Pluggers:

-Hand

-Mechanical.

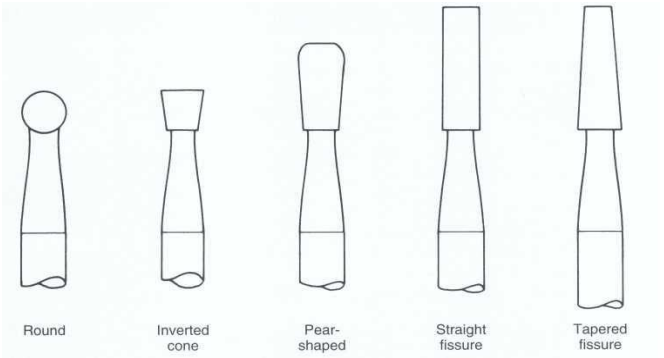
c-Plastic instruments:

-Spatulas.
-Carvers.
-Burnishers.
-Packing instruments.

d-Finishing and polishing instruments:

1- Hand:

-Orange wood sticks.
-Polishing points.
-Finishing strips.



2-Rotary:

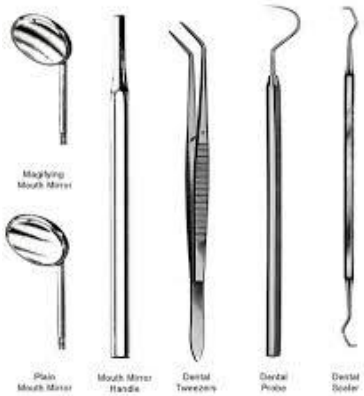
-Finishing burs.
-Mounted brushers.
-Rubber cups.

e-Isolating instruments

-Rubber dam frame, clamp.
- saliva ejector.
-Cotton roll holder.

f-Miscellaneous instruments:

-Mouth mirror.
-Explorer.
-Probes.
Scissors.
-Pliers.



g-Sharpening instruments:

-Stationery sharpening stones.
-Arkansas stone.
-Silicon carbide.
-Al_2O_3.
-Diamond bones.
-Mechanical sharpeners.

h-Abrasive instruments:

-Diamond instruments.
-Others:
-Molded abrasive instruments.
-Discs.
-Wheel stones.
-Coated abrasive instrument.

Most of the hand instruments are composed of three parts:
Hand: Available in various sizes and shapes.
Shank: Serves to connect the handle to working end of the instrument. Normally the are smooth, round and tapered. They have one or more bends to avoid the instrument having tendency to twist in use when force is applied.
Blade: The blade or nib is the working end of instrument and is connected to the handle of the shank. These are available of many designs and sizes depending on function they perform.

Black classification of instruments:
Dr, G.V. Black classified instruments based upon number of shank angles (Mono-angle, Bin-angle and Triple-angle). Dr. G.V. Black classified all instruments by name. He developed a numeric formula to characterize the dimensions and angles of working end.
Black's classification system of instrument categorized instruments by:
Suborder 1: function (Scaler, Excavator).
Order 2: Manner of use (hand condenser).
Subclass 3: Design of working end (spoon excavator).
Class 4: Shape of shank (mon-angle, bin-angle).
These names were combined to form the complete description of the instrument/like **bin angle spoon excavator.**
G.V. Black formula for operative cutting instruments:
-first number: width of blade in tenth of millimeters.
-second number: length of blade in millimeters.
-third number: angle of blade from with the axis of handle. This angle is expressed in hundredths of a circle of centigrade.

The hand instruments are categorized as:
Excavators: Ordinary hatches, Hoe, Angle former and Spoon.
Chisels: Straight chisel, Curved chisel, Bin-angle chisels, Enamels hatchets and GMT.
Others: Knife, Files and Scalers.